COEFFICIENTS FOR DETERMINATION OF THE LEAF AREA IN THREE BURLEY TOBACCO VARIETIES

КОЕФИЦИЕНТИ ЗА ОПРЕДЕЛЯНЕ НА ЛИСТНАТА ПЛОЩ ПРИ ТРИ СОРТА ТЮТЮН ТИП БЪРЛЕЙ

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ABSTRACT

In relation to determination of leaf area through linear measurements of leaf blade and mathematical coefficients in Burley tobacco individual values of correction coefficients have been determined by variety and in dependence of the leaf position.

KEYWORDS: tobacco, leaf area, mathematical coefficient

РЕЗЮМЕ

Във връзка с определянето на площта на листата чрез линейните параметри на листната петура и математически коефициенти при тютюн тип Бърлей, са изчислени индивидуалните стойности на коригиращите коефициенти както по сортове, така и в зависимост от вертикалното положение на листата спрямо стъблото.

КЛЮЧОВИ ДУМИ: тютюн, листна площ, математически коефициент

ПОДРОБНО РЕЗЮМЕ

Познаването и проследяването на процесите на нарастване на листната маса при тютюна през вегетационния период дава възможност за прилагане на диференцирана агротехника в зависимост от конкретните условия на отглеждане. Освен за практиката, определянето на листната площ на растенията има значение и във фундаментален аспект, позволявайки по-пълното изучаване на фотосинтетичната продуктивност на растенията [8].

Във връзка с изпълнението на поставената цел - определяне стойностите на корекционните коефициенти при тютюн тип Бърлей, беше заложен полски опит с три сорта тютюн (Бърлей 1000, Бърлей 1317 и Бърлей 21), които през последните години заемат над 90% от площите, предназначени за тютюн от този тип. За изчисляване на математическите коефициенти бяха определени линейните параметри - дължина по централния нерв (l) и максимална ширина (m) на листната петура от долен, среден и горен пояс (съответно 7, 14 и 21 лист). За определяне действителната площ на листата (A) беше използван електронен цифров площомер (NEO–2, ТУ, София).

Изчислените корекционни коефициенти за определяне на листната повърхност са представени в Таблица 1. Налице са съществени различия между сортовете по отношение на този показател. Сортовете Бърлей 1000 и Бърлей 21 показват по-слабо вариране по пояси, в резултат на което изчислените за тях коефициенти за определяне на листната повърхност са стабилни и се отличават от тези на сорт Бърлей 1317. Последният е значително по-хетерогенен по отношение на този показател, като изчислените стойности по пояси варираха от 0,64 до 0,68. Получените от нас данни за сорт Бърлей 1317 показват определена специфика по отношение формата на листата в зависимост от вертикалното им разположение по стъблото (Фигура 1).

В проведения експеримент се установи, че при сортовете Бърлей 1000 и Бърлей 21 позицията на листата спрямо стъблото не оказва силно влияние върху величината на корекционните коефициенти, определени за различните пояси. Ето защо за тези два сорта във формулата:

A = k.l.m

могат да се използват усреднени стойности на k съответно 0,71 за сорт Бърлей 1000 и 0,69 за сорт Бърлей 21.

За сорт Бърлей 1317 прецизното изчисляване на листната площ е необходимо да се извършва с помощта на изчислените индивидуални коефициенти за всеки пояс на растението – долен (0,64), среден (0,66) и горен (0,68).

INTRODUCTION

Tobacco is a crop that forms its valuable produce exclusively as leaf material. What is important in this case is that not simply the yields should be maximized, but rather a well-balanced growth should be achieved that leads to forming a raw product of high quality. Understanding and following the processes of leaf mass increase during the vegetation period allows for the application of differential cultivation practices as determined by the particular growing conditions. Except for the practical aspects determination of the leaf area of the plants is important in some basic ones as well, where deeper understanding of the photosynthetic productivity of plants can be achieved [8].

Determination of the leaf area can be done by different methods, which can be divided in two groups – destructive and non-destructive ones. The use of the second group gives the possibility to follow the same plants through the vegetation period, which is of particular importance in evaluating breeding material or when the plot size is very small [8]. The use of non-destructive methods is of particular importance when the growth dynamics is studies [5].

In the determination of the area of a single leaf the following formula is routinely used:

(1) A=k.l.m,

where (l) – leaf length, measured on the central nerve,

(m) – maximum leaf width,

(k) – correction coefficient.

Lazarov [2] notes that the correction coefficients may vary in different varieties of the same species, which determines the need for studying them in more detail. Persaud et al. [4] discuss the need for further detailing these coefficients to reflect the differences in leaf shape along the plant height.

There is a limited number of publications on correction coefficient determination in tobacco. According to Torrecilla et al. [7] in Burley KU-17 this coefficient is 0.7010, and according to Suggs et al. [6] in Virginia tobaccos these coefficients vary between 0.62 and 0.70. When determination of the coefficients was performed for the leaves along the stem in variety N.C. 2326 Maw and Mullinix [3] have estimated them to be between 0.50 and 0.59.

The aim of the present study was to determine the values of the correction coefficients in Burley tobacco as affected by genotype and leaf position on the stalk.

MATERIALS AND METHODS

For determination of the correlation coefficient in Burley tobacco a field experiment was set-up in 2003 using the split-plot design with four replications. Three varieties were used (Burley 1000, Burley 1317 and Burley 21) that during the last years cover 90% of the area under Burley tobacco. The linear parameters that were measured were length of the central nerve (l) and maximum leaf width (m) of the leaves from lower, middle and upper zones (7, 14 and 21 leaf respectively). Determination of the actual leaf area (A) was done by electronic leaf area meter (NEO-2, TU, Sofia, Bulgaria). Ten plants were measured in each replication and the obtained values averaged by zones for each variety, by variety for each zone, by zone for all three varieties, and by variety for all three zones. The calculated means were grouped by multiple range test according to Dunnett [1] and with the use of statistical package SPSS for Windows.

RESULTS AND DISCUSSION

The calculated correlation coefficients for determination of leaf area are presented in Table 1. Significant differences were found between the varieties for these coefficients. Varieties Burley 1000 and Burley 21 have lower coefficient variability by zone, resulting in more even coefficients along the stem. Burley 1317 is significantly more heterogeneous for the calculated values and its coefficients varied between 0.64 and 0.68. No significant differences were observed for the coefficients averaged for the three varieties by zones. A close inspection of the Table 1 shows that such averaged coefficients should not be used as universal ones for Burley tobaccos. The gradual increase in the calculated values of the correction coefficient for the Burley 1317 variety from bottom to the top zone results in their narrowing to a more uniform for this type of tobacco one. A confirmation to that can be found in the calculated regression equations (Figure 1). However the observed significant differences in the coefficients calculated by zones require that the peculiarities of each variety be taken into account when precise determination of leaf area is needed. This is of particular importance in the Burley 1317 variety, where the calculated coefficients by zones vary significantly between the lower and the middle leaf position. Although displayed as non-significant (due to the small size of the sample and the variability of the trait under investigation) the difference between the calculated coefficients for the middle and upper leaf position in this variety may proof significant if the sample size could be increased. This is indicated by the equivalence of the difference between the means for the lower and middle and for the middle and upper leaf zones respectively.

As related to the means for the coefficients by variety the analysis of the data in Table 1 reveals that the high variation in Burley 1317 obscures the significance of the differences with Burley 21. Nonetheless the ranking of Burley 21 in a separate from Burley 1000 group and the separation of Burley 1317 by yet another level from Burley 1000 (and in spite of the ranking of the two varieties – Burley 21 and 1317 in the same group c) allow us to insist that the determination and use of individual correction coefficients for each variety is essential. If these coefficients would have been considered without discrimination for the differences in variety behavior, an incorrect conclusion would have been made that one universal correction coefficient is applicable to Burley tobaccos. An example of the effect of such improper use would be to take the available in the literature correction coefficient (for example the one determined by Torrecilla et al.[7]) and use it for determining the leaf area of the lower zone in Burley 1317. The difference between the proposed in the reference correction coefficient (0.70) and the determined in the present study one (0.64) would lead to erroneous leaf area determination by almost 10%. Such a deviation from the correct value is too large to be ignored in conducting research on the photosynthetic productivity of plants or other subjects of basic and applied interest.

The data obtained through this study is in good correlation with the conclusion made by Lazarov [2] on the presence of significant differences in the calculated coefficients within varieties of the same species. The same author has postulated that the leaf shape of the variety is maintained through the vegetation period, which we observed as well for the varieties Burley 1000 and Burley 21. On the other hand the data on Burley 1317 demonstrate a peculiar leaf shape formation pattern alongside the stalk, suggesting therefore differences in leaf shape formation during the vegetation (Figure 1). This finding urges the determination of correction coefficients for leaf area estimation for each new variety and breeding lines of Burley tobacco.

CONCLUSIONS

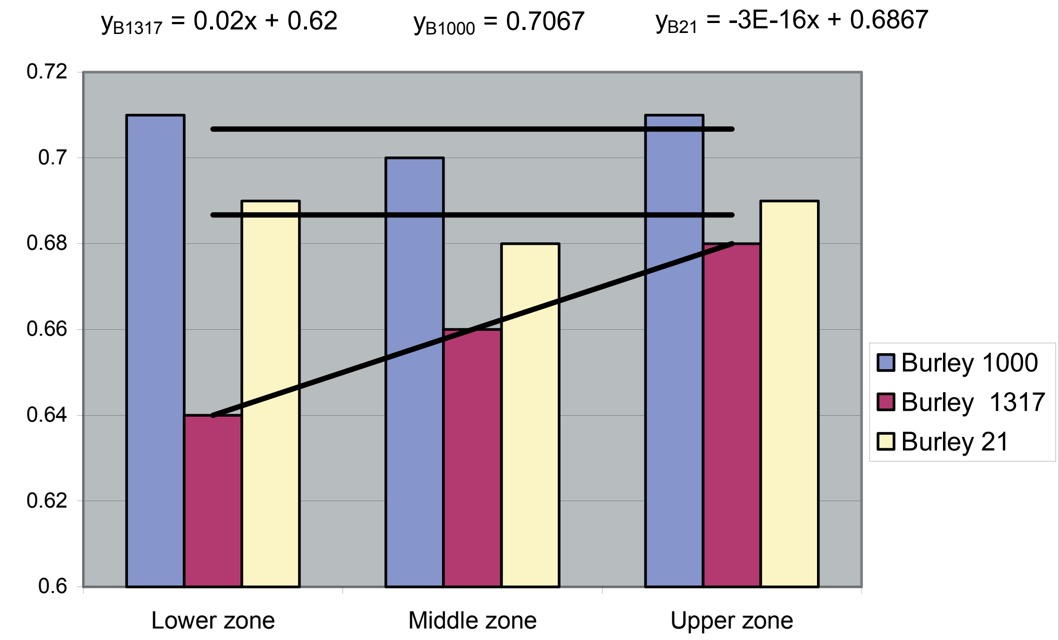
1. The calculated correction coefficients by zones and varieties for three Burley tobaccos are significantly different. The highest coefficient was obtained for Burley 1000 and the lowest – for Burley 1317.
2. Due to the significant differences in variety behavior, individual correction coefficients should be used for each variety.
3. In Burley 1000 and Burley 21 leaf position on the stalk did not affect the value of the correction

Table 1. Coefficients for calculating leaf area of Burley tobacco by leaf position and variety.
Таблица 1. Коефициенти за определяне на листната повърхност по пояси и сортове на тютюн тип Бърлей.

Variety	Lower zone	Middle zone	Upper zone	Average
Burley 1000	$0{,}71^{a, 1*}$	$0{,}70^{a, 1}$	$0{,}71^{a, 1}$	$0{,}71^{a}$
Burley 1317	$0{,}64^{c, 1}$	$0{,}66^{c, 2}$	$0{,}68^{b, 2}$	$0{,}66^{c}$
Burley 21	$0{,}69^{b, 1}$	$0{,}68^{b, 1}$	$0{,}69^{b, 1}$	$0{,}69^{bc}$
Average	$0{,}68^{1}$	$0{,}68^{1}$	$0{,}69^{1}$	

* - multiple ranking according to Dunnet (1965). Letters denote ranking of the varieties by different zones and by the average from each zone; numbers denote ranking of the zones inside each variety and as average from all varieties.

Figure 1. Coefficients for calculating leaf area by leaf position and variety and regressions by leaf position
Фигура 1. Коефициенти за определяне на листната повърхност по сортове и пояси и регресии по пояси



coefficient. Therefore for these two varieties the value of k in the formula : A = k.l.m

should be 0.71 for Burley 1000 and 0.69 for Burley 21.

4. In Burley 1317 the exact calculation of the leaf area should be done with different coefficients for different plant zones – 0.64 for the lower zone, 0.66 for the middle one and 0.68 for the upper zone.

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